

I CLAIM:

1. A method for forming via powder metallurgy a compacted tungsten-containing article, the method comprising:

preparing a powder-based mixture that includes at least a tungsten-containing component and a binder component;

compacting the mixture to produce an intermediate structure having an outer surface;

strengthening the intermediate structure;

reshaping the intermediate structure to produce an at least near net final shape article having an outer surface;

applying a sealant to the at least near net final shape article; and

infiltrating the sealant beneath the outer surface of the at least near net final shape article.

2. The method of claim 1, wherein the strengthening includes applying a sealant to the intermediate structure prior to the reshaping step and infiltrating the sealant beneath the outer surface of the intermediate structure.

3. The method of claim 2, wherein the infiltrating step includes infiltrating the sealant via vacuum impregnation.

4. The method of claim 2, wherein the strengthening step further includes curing the sealant.

5. The method of claim 1, wherein the strengthening step includes heating the intermediate structure.

6. The method of claim 1, wherein the strengthening step includes activating at least a portion of the binder component.

7. The method of claim 6, wherein the binder component includes a curable non-metallic binder component and the activating step includes curing the curable binder component.

8. The method of claim 7, wherein the binder component further includes at least one metallic binder component.

9. The method of claim 6, wherein the activating step includes heating the intermediate structure to a temperature that is less than the melting point of the at least one binder component.

10. The method of claim 1, wherein the binder component includes at least a metallic binder component and a non-metallic binder component.

11. The method of claim 10, wherein the metallic binder component includes tin and the non-metallic binder component includes a heat-activated polymeric binder component.

12. The method of claim 1, wherein the tungsten-containing component includes at least one of ferrotungsten and an alloy of tungsten, nickel and iron.

13. The method of claim 1, wherein the tungsten-containing component forms a majority component of the mixture, and further wherein tungsten forms a majority component of the tungsten-containing component on an element-by-element basis.

14. The method of claim 1, wherein the infiltrating step includes infiltrating the sealant via vacuum impregnation.

15. The method of claim 1, wherein the method further includes curing the sealant.

16. The method of claim 1, wherein the reshaping step includes compressing the intermediate structure to reform the intermediate structure to a shape that is different from its shape prior to the reshaping step.

17. The method of claim 16, wherein the reshaping step includes compressing the intermediate structure with at least one punch having a face that does not correspond to the shape of the intermediate structure.

18. The method of claim 1, wherein the reshaping step includes plastically deforming the intermediate structure to a shape that is different from its shape prior to the reshaping step.

19. The method of claim 1, wherein the reshaping step includes grinding the intermediate structure to remove at least a portion of the intermediate structure.

20. The method of claim 19, wherein the portion includes a projecting shoulder.

21. The method of claim 19, wherein the grinding step includes removing material from the intermediate structure to from an arcuate portion from a projecting edge portion of the intermediate structure.

22. The method of claim 1, wherein after the infiltrating step, the at least near net final shape article includes sealant on the outer surface of the at least near net final shape article, and further wherein the method includes removing sealant from the outer surface of the at least near net final shape article.

23. The method of claim 22, wherein the method further includes plating the at least near net final shape article.

24. The method of claim 1, wherein after the infiltrating step, the at least near net final shape article includes sealant on the outer surface of the at least near net final shape article, and further wherein the method does not include plating the at least near net final shape article.

25. An article formed by the method of claim 1.

26. The article of claim 25, wherein the article is a firearms projectile.

27. The article of claim 25 in combination with at least a casing, a priming mixture and a charge to form a firearms cartridge.

28. The article of claim 25, wherein the article is a weight.
29. The article of claim 25, wherein the article is a radiation shield.
30. The article of claim 25, wherein the article is a medical imaging marker.

31. A method for producing a firearms cartridge containing at least one tungsten-containing projectile, the method comprising:

compacting a tungsten-containing mixture of powders to form a compacted structure having an outer surface, wherein the mixture of powders includes at least one tungsten-containing component and at least one binder component, wherein the at least one binder component includes a metallic binder component, and further wherein the compacted structure has a density of at least 9 g/cc;

applying a sealant to the compacted structure;

infiltrating the sealant beneath the outer surface of the compacted structure;

curing the sealant; and

assembling a firearms cartridge containing the compacted structure as a firearms projectile.

32. The method of claim 31, wherein after the infiltrating step, the outer surface of the compacted structure includes sealant, and further wherein the sealant on the outer surface is not removed prior to the assembling step.

33. The method of claim 31, wherein the method further includes reshaping the compacted structure after the curing step.

34. The method of claim 33, wherein the method further includes resealing the compacted structure after the reshaping step.

35. The method of claim 33, wherein the reshaping step includes grinding the compacted structure to remove material therefrom.

36. The method of claim 31, wherein the method further includes strengthening the compacted structure prior to the reshaping step.

37. The method of claim 31, wherein the at least one binder component further includes at least one non-metallic binder component.

38. The method of claim 31, wherein the method includes heating the compacted structure.

39. The method of claim 31, wherein the method includes plating the compacted structure.

40. A firearms cartridge, comprising:
a casing;
a primer within the casing;
a propellant within the casing; and
a frangible tungsten-containing firearms projectile, the projectile including a body with a central interior region and an outer surface, and a sealant extending beneath the outer surface but not distributed throughout the central interior region.

41. The projectile of claim 40, wherein the cartridge includes a plurality of the projectiles.

42. The projectile of claim 40, wherein the projectile includes at least a tungsten-containing component and a binder component.

43. The projectile of claim 42, wherein the tungsten-containing component includes at least one of ferrotungsten and an alloy of tungsten, nickel and iron.

44. The projectile of claim 42, wherein the binder component includes at least a metallic binder component and a non-metallic binder component.

45. The projectile of claim 44, wherein the projectile further includes a lubricant.

46. The projectile of claim 41, wherein the projectile is formed via powder metallurgy.

47. The projectile of claim 41, wherein the projectile further includes a plating layer.

48. The projectile of claim 41, wherein the projectile further includes a jacket.

49. The projectile of claim 41, wherein the cartridge is a shot shell.

50. The projectile of claim 41, wherein the cartridge is a bullet cartridge.